User's Manual

VER. 1.0

MODEL TH1912/A

4 1/2 Digit AC MilliVoltmeter

Contents

Chapter 1 Introduction....1
1.1Discription....1
1.2Using condition....2
1.2.1 Power....2
1.2.2 Environmental temperature and humidity....2
1.3 Dimention and weight....2
1.4 Safety symbols and Precautions....2
1.5 Incoming Inspection....3
1.6 Warranty....3
1.7 Limitation of Warranty....3
Chapter 2 Model TH1912 Digital Millivoltmeter introduction....5
2.1 Introduction....5
2.2 Introduction of front panel....5
2.2.1 Annunciators on Screen....7
2.2.2 Overview of front panel....7
2.2.3 Front panel menu reference....8
2.2.4 Menu operation introduction....9
2.3 Introduction of rear panel....9
2.4 Startinging up preparation and status....10
2.4.1 Power Line Connection....10
2.4.2 Input Terminals....11
2.4.3 Power-up Sequence....11
2.4.4 High Energy Circuit Safety Precautions....11
2.4.5 Power-on Defaults....12
2.4.6 Warm-up time....13
2.5 Display....13
Chapter 3 Basic Measurements....14
3.1 Preparation....14
3.2Measuring voltage....14
3.3Select secondary display....15
3.3.1 Operation....15
3.4 Math operation function....15
3.4.1 Percent....16
3.4.2 dB calculation....16
3.4.3 dBm calculation....17
Chapter 4 Measurement Options....19
Measurement configuration....19
4.1.1 Range....19
4.1.2 Relative....20
4.1.3 Rate....21

4.2 Trigger operation....21
4.2.1 Trigger procedure....21
Reading Hold....22
4.3 MAX/MIN....23
4.4 Compare Operations....23
4.4.1 Enabling compare....23
4.4.2 Setting Compare Limit Values....23
4.5 System Operations....24
4.5.1 Beep....24
4.5.2 Key Sound....25
4.5.3 Self-test....25
Chapter 5 Remote Operation....26
5.1 RS-232 Interface Operation....26
5.1.1 RS-232 Connection....26
5.1.1RS-232 operation....27
(2) Sending and receiving data....28
(3) Selecting Baud Rate....28
(4) Software Protocol....28
5.2 Data format....29
Chapter 6 SCPI Command Reference....31
6.1 Command structure....31
6.2 Command Syntax....31
6.1.1 Commands and command parameters：....31
6.2.2 Short-form Rules....33
6.2.3 Basic Rules of Command Structure....34
6.2.4Multiple Command Rules....34
6.2.5 Command Path Rules....34
Command Reference....36
6.3.1 DISPlay subsystem....36
6.3.2 FUNCtion subsystem....36
6.3.3 VOLTage subsystem....37
6.3.4 HOLD subsystem....42
6.3.5 TRIGger subsystem....43
6.3.6 FETCH Subsystem....44
6.3.7 Common Commands....44
Appendix A....46
Introduction....46
Appwndix B....48
Example of program....48

Chapter 1 Introduction

Thanks very much for choosing and using our product. If you have any questions after reviewing this manual, please contact your local representative or call directly to our application engineers for further consultation.

1.1 Discription

Model TH1912（5Hz — 3MHz）and TH1912A(5Hz — 5MHz) are 4½ Dual VFD display Dual channel AC Millivoltmeter, which can also be used as power meter and level meter. The test value and operation value can be displayed. The operation of intelligent mico processor control technology, good amplifier and A/Dlinearity cymoscope make the deviation of test voltage lower than 1%. Chip production and installing craft make the millivoltemeter with the good performance of small volume, light, high stability, fast test speed, small deviation of frequency reponse.etc.

TH1912/A has wide test range：

·4½ dual reading bright VFD display.

·Voltage range：50μV~300Vrms,500V peak value.

·Power level：-83.8dBm~51.76dBm(0dBm=1mW ，600Ωload).

·Power：0.00417nW~150W(load resistance R=600Ω,load resistance can be set)

·Voltage level dBV range：-86dBV~49.54dBV（0dBv=1V)

·Voltage level dBmV range：-26dBmV~109.5dBmV(0dBmV=1mV)

·Voltage level dBμV range：34dBμV~169.54dBμV(0dBμV=1μV)

·Input resistance：1MΩ, parallel capacitance is about 30pF

·Voltage test probe：when ×10，input resistance is 10MΩ（test accuracy can't be guaranteed）.

·Max,Min recording function and percent ， menu function setting calculation.Multi-function can combine dual digit VFD display.

·Source impedance setting test power of different signal source and dBm value.

·Float and GND setting，meeting different test demands.

·Auto and manual range switch function.

·Programming language and control interface：Millivoltmeter provides SCPI programming control language，providing RS-232 C control interface.

.

1.2 Using condition

1.2.1 Power

Power voltage：220V±10%
Power frequency：50Hz/60Hz±5%
Consumption： ≤ 10VA

1.2.2 Environmental temperature and humidity

Normal working temperature：0℃～40℃，humidity ≤ 90%RH

1.3 Dimension and weight

Dimension（W×H×D）：225mm×100mm×315mm
Weight: about 2.5 Kg

1.4 Safety symbols and Precautions

The symbol on the instrument indicates that user should refer to the operating instructions located in the manual before performing.

The symbol on the instrument shows that high voltage may be present on the terminal(s). Be careful to avoid personal contact with these voltages.

The symbol on the instruments means earth grounding.

The **WARNING** heading used in the manual explains high voltage danger that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the manual reminds user that hazards could damage the instruments if not according to operating instructions. Such damage may invalidate the warranty.

1.5 Incoming Inspection

The TH1912/A was carefully inspected mechanically and electrically before shipment. After unpacking all items from the shipping carton, please check for any obvious signs of physical damage that may have occurred during transportation. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. The following items are included with every Model TH1912/A order:

- Model TH1912/A $4^1/_2$ Digital AC Milivoltmeter
- Test leads (Model TH26036)
- Power cord
- Two 500mA fuses
- Two 1A fuses
- Operation Manual
- Quality and warranty certificate
- Test report
- Other optional accessories if ordered

Verify that you have received all the items above when you get Milivoltmeter. If anything is missing, please contact our representative or our sales office.

1.6 Warranty

Tonghui warrants this product to be free from defects in material and workmanship for a period of 2 years from the date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

1.7 Limitation of Warranty

This warranty does not apply to defects resulting from product modification without our express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, or problems arising from normal wear or failure to follow instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES.

NEITHER TONGHUI ELECTRONICS NOR ANY OF ITS EMPLOYEES SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF ITS INSTRUMENTS AND SOFTWARE EVEN IF TONGHUI ELECTRONICS HAS BEEN ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH

DAMAGES. SUCH EXCLUDED DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO: COSTS OF REMOVAL AND INSTALLATION, LOSSES SUSTAINED AS THE RESULT OF INJURY TO ANY PERSON, OR DAMAGE TO PROPERTY.

Chapter 2 Model TH1912 Digital Millivoltmeter introduction

2.1 Introduction

Model TH1912 4½ Digital AC Millivoltmeter is a kind of fast and accurate AC voltage test instrument. Compact front panel design can help you get the required test function quickly, its inherent test platform and system feature can provide an ideal resolution for your voltage test demand now and I the future.

Convenient test platform feature：

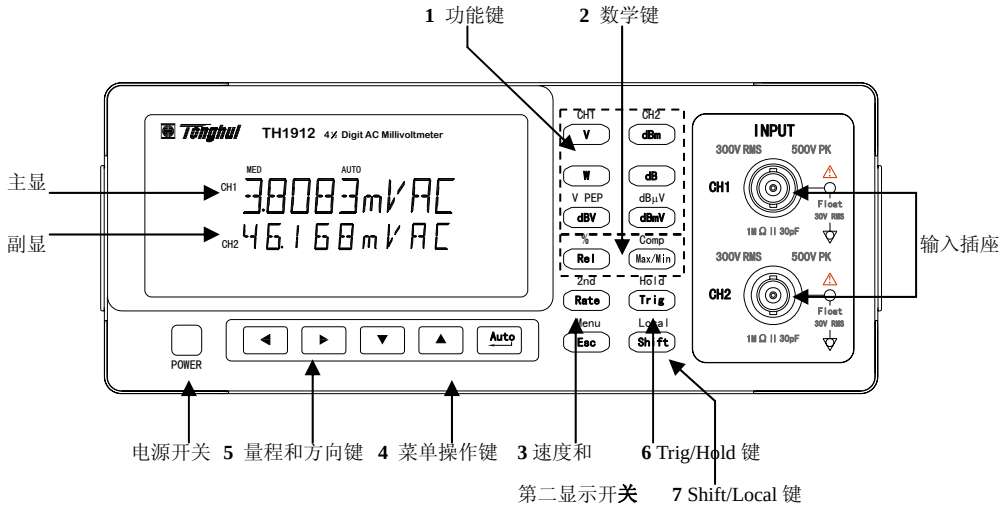
- High brightness VFD Dual display
- Built-in math operation function
- Set signal power of different impedance and dBm relative value.
- Reading hold function by manual setting
- Convenient outline design

Flexible system feature：

- RS-232 interface
- Standard program language SCPI
- Reading rate 25 reading/s
- COMP compare test with HI/IN/LO signal

2.2 Introduction of front panel

The front panel of the TH1912 is shown in Figure 1-1. This figure includes some important abbreviated information that should be reviewed before operating the instrument.



1. Function key

Select test function: AC voltage valid value（V）, voltage peak-peak value（Vp-p）,power（W）, power level（dBm）, voltage level（dBV、dBmV、dBμV）,relative test value（dB）.

2. Numeric key

Turn on or off math function（Rel /%，Max/Min/Comp，Hold）

3. 2nd Display and speed key.

Rate Changes reading rate: Fast, Medium and Slow.

Shift → Rate turns on/ off the 2nd parameter display.

4. Menu operation keys

Shift → Esc Open/Close menu

◀ Move through selections within menu level, command level or parameter level

▶ Move through selections within menu level, command level or parameter level.

▲ Move up a level.

▼ Move down a level.

Auto (ENTER) Save the change made on “parameter” level, and return to the “command” level.

Esc Cancel the change made on “parameter” level, and return to the “command” level.

5. Range and Combination function selecting keys

◀ Select a 2nd display parameter

▶ Select a 2nd display parameter

▲ Select a higher range and disable auto ranging.

▼ Select a lower range and disable auto ranging.

Auto Toggle between auto ranging and manual ranging.

6. Trig/Hold key

Trig　　Trigger a measurement from the front panel.

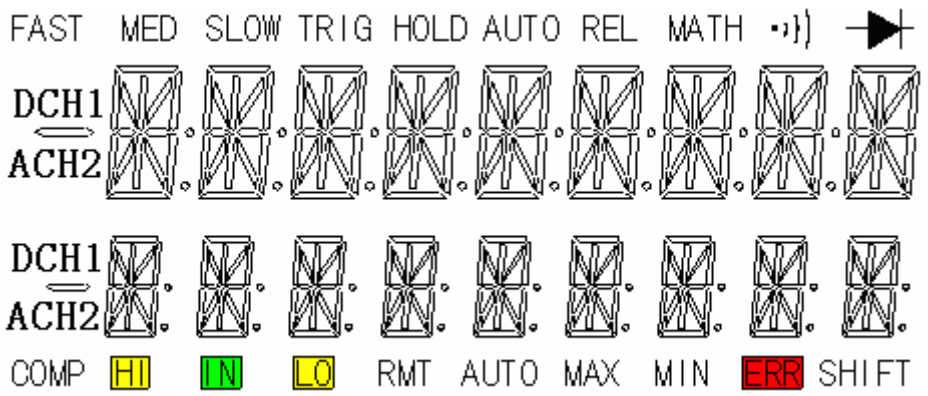
Shift → Trig　　Hold a stable reading on the display

7. Shift/Local key

Shift　　Used to access shifted keys.

Shift（Local）　　Cancel RS232C remote control mode and back to the LOCAL mode.

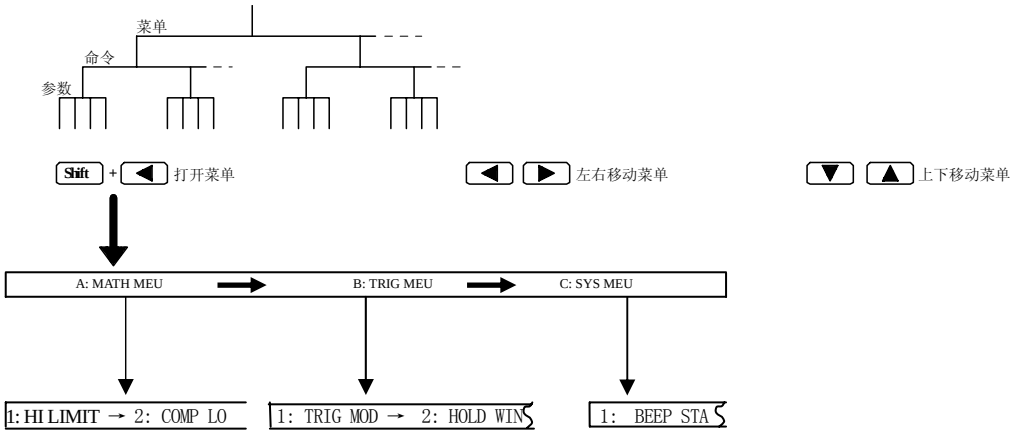
2.2.1 Annunciators on Screen



FAST　　Fast reading rate
MED　　Medium reading rate
SLOW　　Slow reading rate
TRIG　　Indicates external trigger (front panel, bus) selected.
HOLD　　Reading HOLD function is enabled
AUTO　　Auto ranging enabled
REL　　Relative operation function
CH1、CH2　channel indication
COMP　　Turn on limit compare test function
HI IN LO limit compare high pass, pass and low pass indication
RMT　　Milivoltmeter is in remote control mode
AUTO　　Auto ranging enabled
MAX MIN Max/Min The indication of Max. and Min. value
ERR　　Hardware or remote control error detected
SHIFT　　Accessing shifted keys

2.2.2 Overview of front panel

The menu of TH1912 is organized by 3 classes (menu, command,)“top-down”tree structure.



Press Auto to confirm

A：MATH MENU

1: COMP HI → 2:COMP LO → 3:PERC REF → 4:dB REF→ 5:dBm REF8

B：TRIGger MENU

1: TRIG MODE → 2:HOLD WIN → 3:HOLD CNT

C：SYStem MENU

1:BEEP STR → 2:KEY SONG → 3:BAUD RATe → 4:Tx TERM →5:GND STA

2.2.3 Front panel menu reference

A：MATH MENU

1:COMP HI	Set high limit for COMP
2:COMP LO	Set low limit for COMP
3:PERC REF	Set reference value for PERCENT
4:dB REF	Load or set dB reference value saved in register
5:dBm Zx	Load or set load reference value saved in register

B：TRIG MENU

1:TRIG MODE	Select trigger mode(IMM/MAN/BUS)
2:HOLD WIN	Set the reading hold sensitivity band.
3:HOLD CNT	COUNT of readings for reading hold.

C：SYS MENU

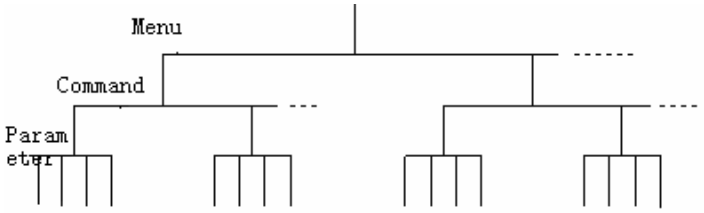
1:BEEP STR	Enable or disable the beeper function
2:KEY SONG	Enable or disable the key sound
3:BAUD RAT	Select baud rate of RS232C interface
4:TX TERM	Set ending character in RS232C transmission

5:GND STA　　Set input signal ground or float

2.2.4 Menu operation introduction

The section briefly introducts how to use the menu of front panel. It is suggested that operator should know and hold the menu structure and operation.

Menu is designed by top-bottom 3 classes(Menus,Commands,Parameters) tree structure. You can use ▲ or ▼ to move menu tree from one class to the next one；use ◄ or ► to view the same-class option of any classes.



·Turn on menu，press Shift + Esc (Menu)key.

· Turn off menu，press Shift + Esc (Menu)，or any function key or math function key.

· Confirm a menu command，press Auto (Enter) key.

Note：TH1912 is set singlely in each channel，the default setting is the channel selected by primary display. Or in"Parameter"class, press Shift + ▲ or ▼ to switch setting channel. When in "MENU"class，if you press ▲, you can't be back to a higher menu；and in "Parameter"，if press ▼, a lower menu can't be available.

2.3 Introduction of rear panel

The rear panel of TH1912 is shown as Figure 2-2，this section includes many importance information before operation.

1. RS-232

Used for RS-232 interface operation,DB-9 cable must be used.

2. Ground

The ground terminal of instrument.

3.Power jack

The input terminal of AC power, which can be used for AC voltage 110V/220V±10%,50Hz/60Hz±5%。

4.Fuse

Used for protecting instrument，220V/0.5A。

5. Power input converted switch

Used for switching AC 110V/ and 220V input. The default is AC 220V.

6. Platename

Record the No.of instrument.

2.4 Starting up preparation and status

2.4.1 Power Line Connection

Follow the procedure below to connect the TH1912/A to line power and turn on the instrument.

1. Check to make sure that the line voltage is in the range of 198V to 242V (or 110V±10%) and line frequency is in the range of 47.5 to 52.5Hz (or 60Hz±5%) before connecting the power cord.

CAUTION: Operating the instrument on an incorrect voltage may cause damage to the instrument, possibly voiding the warranty.

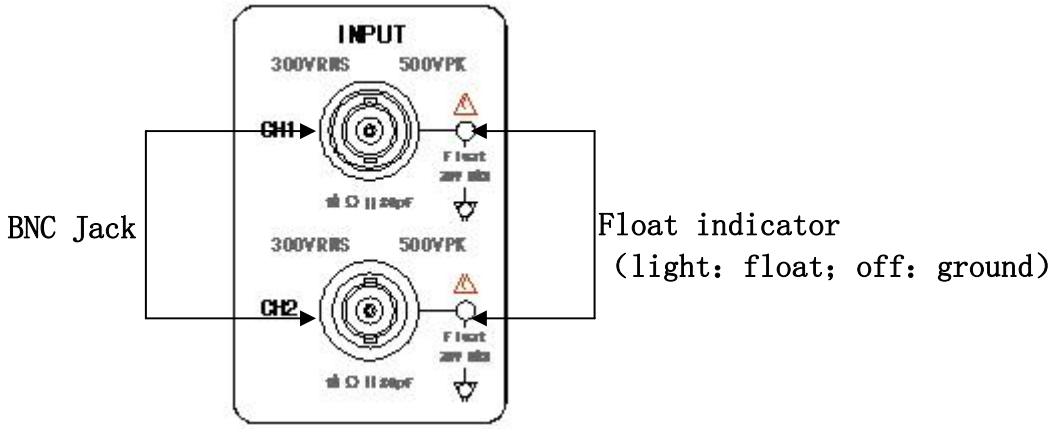
2. Before plugging in the power cord, make sure that the front panel power switch is in the off position.
3. Connect the female end of the supplied power cord to the AC receptacle on the rear panel. Connect the other end of the power cord to a grounded AC outlet.

WARNING: The power cord supplied with the Model TH1912/A contains a separate ground wire for use with grounded outlets. When proper connections are made, instrument chassis is connected to power line ground through the ground wire in the power cord. Failure to use a grounded outlet may result in personal injury or death due to electric shock.

4. Turn on the instrument by pressing the front panel power switch and get ready for measuring.

2.4.2 Input Terminals

Input terminal function is shown as Figure 2-3.



2.4.3 Power-up Sequence

On power-up, Model TH1912 performs self-tests on its EPROM and RAM and lights all segments and annunciators for about 1 second. If a failure is detected, the instrument momentarily displays an error message and the ERR annunciator turns on.

If the instrument passes self-tests, the firmware revision will be displayed.

2.4.4 High Energy Circuit Safety Precautions

To optimize safety when measuring voltage in high energy distribution circuits, read and

use the directions in the following warning.

When making measurements in high energy circuits, use test leads and accessories that meet the following requirements:

- Test leads and accessories must be fully insulated.
- Only use test leads that can be connected to the circuit (e.g., alligator clips, spade lugs, etc.) for hands-off measurements.
- Do not use test leads or accessories that decrease voltage spacing. This diminishes arc protection and creates a hazardous condition.

Use the following sequence when measuring high energy circuits:

1. De-energize the circuit using the regular installed connect-disconnect device, such as a circuit breaker, main switch, etc.
2. Attach the test leads to the circuit under test. Use appropriate safety rated test leads for this application.
3. Set the Milivoltmeter to the proper measurement function and range.
4. Energize the circuit using the installed connect-disconnect device and make measurements without disconnecting the Milivoltmeter.
5. De-energize the circuit using the installed connect-disconnect device.
6. Disconnect the test leads from the circuit under test.

WARNING: The maximum common-mode voltage (voltage between COM and the chassis ground) is 500V peak. Exceeding this value may cause a breakdown in insulation, creating a shock hazard.

2.4.5 Power-on Defaults

Model TH1912 uses the factory default settings for the power-on settings.

Since the basic measurement procedures in this manual assume the factory defaults, reset the instrument to the factory settings when following step-by-step procedures. Table 2-1 lists the factory default settings.

Table 2-1 Factory Default Settings

Setting	Factory Default
Function	DCV
Range	AUTO
Rate	Medium
Remote/Local	Local
Trigger Mode	Immediate
Relative Mode	OFF
Compare Mode	OFF
HI Limit	+1
Lo Limit	-1
Percent Mode	OFF
Reference	+1
Max/Min Mode	OFF
Reading Hold	OFF
Secondary Display Mode	OFF
Cal Mode	OFF

2.4.6 Warm-up time

Model TH1912 is ready for use as soon as the power-up sequence has completed. However, to achieve rated accuracy and stability, allow the instrument to warm up for half an hour. If the instrument has been subjected to extreme temperatures, allow additional time for internal temperatures to stabilize.

2.5 Display

The display of Model TH1912 is primarily used to display readings, along with the units and type of measurement. Annunciators located on the left, right and bottom indicate various states of operation. See section 2.2.1 for a complete listing of annunciators.

Chapter 3 Basic Measurements

3.1 Preparation

One of the first things you would like to do with your Milivoltmeter is to become acquainted with its front panel. We have provided some exercises in foregoing chapters about preparations for use and operations of front panel.

The front panel has six rows of keys to select various functions and operations. Most keys have a shifted function printed in blue above the key. To perform a shifted function, press Shift (the **Shift** annunciator will turn on). Then, press the key that has the desired label above it.
If you accidentally press Shift, just press it again to turn off the **Shift** annunciator.

3.2 Measuring voltage

TH1912 voltage ranges：3.8 mV, 38mV, 380mV, 3.8V, 38V ,300V（500V peak value）；highest resolution 0.1μV(In 3.8mV range).

Connection method

If TH1912 is under the setting condition, the operational procedure is：

1. Voltage probe BNC is connected to BNC jack（when testing small voltage, probe ground line should be short as possible to avoid voltage interference）.
2. Press Auto to lock auto range function. After booting this function, be attention **AUTO** lights. If you need manual range, use ▲ and ▼ to select the test range of required voltage.
3. Read the reading on the display.

3.3Select secondary display

At default status, secondary display is displayed by ◀ or ▶.

Assembled display of secondary parameter，the group is listed as Figure 3-1

3.3.1 Operation

1. Press Shift + Rate to open secondary display function.
2. Press ◀ or ▶ to select the assembled group of each secondary parameter in primary display function, details in shown as figure.
3. Press Shift + Rate again to turn off secondary display function, and primary display can't be affected.

Figure 3-1

Primary display	Secondary display						
	▶						◀
V	dBm	dB	W	dBV	Vp-p	dBmV	dBμV
dBm	dB	W	dBV	Vp-p	dBmV	dBμV	V
W	dBV	Vp-p	dBmV	dBμV	V	dBm	dB
dB	W	dBV	Vp-p	dBmV	dBμV	V	dBm
dBV	Vp-p	dBmV	dBμV	V	dBm	Vp-p	W
dBmV	dBμV	V	dBm	Vp-p	W	dBV	Vp-p
Vp-p	dBmV	dBμV	V	dBm	dB	W	dBV
dBμV	V	dBm	dB	W	dBV	Vp-p	dBmV
Percentage (%)	%						
Comp	HI，IN，LO，PASS，FAIL						
Max/Min	Max			Min			

3.4 Math operation function

There are 3 kinds of math operation in TH1912：

- Percentage
- dB
- dBm

The procedure of selecting and setting math function is as below:

Press corresponding math function key to turn on the function.

Set the parameter of math function, and press [Auto] to confirm.（If press the math function key, the math function will be cancelled.）

3.4.1 Percent

Percent operation is based on the reference value you set：

$$\text{Percent} = \frac{\text{Input} - \text{Reference}}{\text{Reference}} \times 100\%$$

Where： Input General display reading on the screen

Reference User inputting parameter

Percent Calculated result

Application：

The application of Percent math function, please operate based on the following methods：

Press [Shift] + [Rel] to select Percent math function, Percent value is displayed on secondary display.

After opening Percent math function，if you need to change reference value,the following operation can also be performed except the description above：

1. Press [Shift] + [Esc] again to load **3:PERC REF** command of **A:MATH MEU**，press [▼] to enter parameter setting： +1.0000∧。
2. use [◀] and [▶] to select the required digit，then use [▲] and [▼] to add or subtract value, and input a required value and unit.
3. Press [Auto] to confirm reference value.

Model TH1912/A will display measurement result of calculation. If the value of “Input” is larger than that of “Reference”, displayed result will be positive; contrarily, it will be negative if the value of “Input” is smaller than that of “Reference”.

3.4.2 dB calculation

Expressing DC and AC voltage in dB makes it possible to compress a large range of measurements into a much smaller scope. The relationship between dB and voltage is defined by the following equation:

$$dB = 20 \log \frac{V_{IN}}{V_{REF}}$$

Where: V_{IN} is the DC or AC input signal.

V_{REF} is the specified voltage reference level

The instrument will read 0dB when the reference voltage level is applied to the input.

If a relative value is in effect when dB is selected, the value is converted to dB then REL is applied to dB. If REL is applied after dB has been selected, dB has REL applied to it.

1. Application：

Press **dB** to select dB math function，dB value is displayed on secondary display.

After opening dB math function，if you need to change reference value, the following operation can also be performed：

1. Press Shift + ▶ to load **4:dB REF** command in **B:MATH MENU**，press ▼ key to enter parameter setting：REF：+0.00000.
2. Use ◀ and ▶ to select the digits，then use ▲ and ▼ to increase or decrease the value, input a demanded value.
3. Press Auto to confirm the set reference voltage value.

Note： 1. In calculating dB，say V_{IN}/V_{REF} absolute value.

2. The Max.negtive dB value is -160dB, when，V_{IN} = 1．V, V_{REF} = 1000V.

2. TH1912 dual channel dB operation function

TH1912 has the function of channel dB operation，which can perform dB operation on signal test value of dual channels. The method is：

Press Shift + dB key to open channel dB，now the flashing channel indicates reference value，use ▲ and ▼ to change reference channel. Press Auto to confirm the selected reference channel，the primary display is dB value. Use ▲ and ▼ to select CH1/CH2 or CH2/CH1.

If selecting a same channel to perform dB，now V_{REF} is the test value of reference channel when pressing Auto. Press ▲ and ▼ can display reference voltage value.

3.4.3 dBm calculation

dBm is defined as decibels above or below a 1mW reference. With user-programmable reference impedance, Model TH1912/A reads 0dBm when the

voltage needed to dissipate 1mW through the reference impedance is applied. The relationship between dBm, reference impedance, and the voltage is defined by the following equation:

$$dBm = 10 \log \frac{(V_{IN}^2 / Z_{REF})}{1mW}$$

Where: V_{IV} is the DC or AC input signal.

Z_{REF} is the specified reference impedance.

If a relative value is in effect when dBm is selected, the value is converted to dBm then REL is applied to dBm. If REL is applied after dBm has been selected, dBm has REL applied to it.

Application：

Press **dBM** to select dBm math function，the secondary display is the dBm value.

1. Press Shift →▶ to load **5:dBm Zx** command in **B:MATH MENU**，press ▼ to enter parameter setting：REF：0000.

2. Use ◀ and ▶ keys to choose a numerical place and use ▲ and ▼ keys to increment or decrement the digits. Enter a value from 1Ω to 9999Ω.

3. Press Auto (ENTER) to confirm the reference impedance.

NOTES: The reference impedance and input impedance mentioned in this chapter are totally different. Input impedance is inherent in the instrument and could not be changed via foregoing methods.

dBm is valid for both positive and negative DC voltage.

The percent math operations are applied after the dBm or dB math.

Chapter 4 Measurement Options

This chapter provides description of the front panel features of TH1912. For those measurement options accessible only by a remote interface, this chapter is organized as follows:

Measurement Configuration – Describes Ranging, Relative readings, Digits of Resolution and Measurement rate
Triggering operations – Explains trigger sources
MAX and MIN operations – Records the minimum and the maximum input signals
Limit operations – Defines how to set reading limits
System Operations – Provides details on Beep setup, Baud rate setup, Terminal character setup and key sound setup up

Measurement configuration

The following paragraphs discuss configuring Milivoltmeter for making measurement.

4.1.1 Range

You can let the millivoltmeter automatically select the range using auto ranging or you can select a fixed range using manual ranging. Auto ranging is convenient because the millivoltmeter automatically selects the appropriate range for each measurement. However, you can use manual ranging for faster measurements since the millivoltmeter doesn't have to determine which ranging to use for each measurement. The millivoltmeter returns back to auto ranging when power has been off or after a remote interface reset.

Maximum readings
The full scale readings for every range on each function are 5% over range

Manual ranging
To select a range, simply press ▲ or ▼ key. The instrument changes one range per key press. The selected range is displayed for a moment.

If the instrument displays the "**OVL.D**" message on a particular range, select a higher range until an on-range reading is displayed. Use the lowest range possible without causing an overflow to ensure best accuracy and resolution.

Auto ranging

To enable auto ranging, press Auto key. The **AUTO** annunciator turns on when auto ranging is selected. While auto ranging is selected, the instrument automatically chooses the best range to measure the applied signal. However, auto ranging should not be used when optimum speed is required.

Note that up-ranging occurs at 105% of normal range and down-ranging occurs at 5% of normal range.

To cancel auto ranging, press Auto or ▲ or ▼ key. Pressing Auto to cancel auto ranging leaves the instrument on the present range.

4.1.2 Relative

The relative operation could be used to null offsets or subtract a baseline reading from present and future readings. When relative function is enabled, Model TH1912 uses the present reading as a relative value. Subsequent readings will be the difference between the actual input value and the relative value.

You can define a relative value for each function. Once a relative value is set for a measurement function, the value is the same for all ranges. For example, if 2V is set as a relative value on the 20V range, the relative is also 2V on the 1000V, 100V, 1V or 100mV ranges.

Additionally, when you perform a zero correction for DCV, Ω measurements by enabling REL, the displayed offset becomes the reference value. Subtracting the offset from the actual input zeroes the display, as follows:

Displayed reading = Actual Input – Reference

Note: as for some range, REL function won't increase the Max.allowing input signal, for example: in 3.8V range, for the input signal higher than 3.9V, TH1912 still display "**OVL.D"**.

To set a REL value, press Rel when the display shows the value you want as the relative value. The REL annunciator turns on. Press Rel a second time to disable REL.

4.1.3 Rate

The RATE operation sets the integration time of the A/D converter, the period of time the input signal is measured. The integration time affects the usable digits, the amount of reading noise, as well as the ultimate reading rate of the instrument.
In general, the fastest integration time (FAST set from the front panel or remote interface) results in increased reading noise and fewer usable digits, while the slowest integration time provides the best common-mode and normal-mode rejection. In-between settings are a compromise between speed and noise.
The RATE parameters are explained as follows:

Fast

FAST sets speed to 25 readings per second. Use FAST, if speed is of primary importance, however it is at the expense of increased reading noise and fewer usable digits.

Medium

Medium sets speed to 10 readings per second. Use Medium when a compromise between noise performance and speed is acceptable.

Slow

Slow sets speed to 5 readings per second. SLOW provides better noise performance at the expense of speed.

Note: ***The integration time can be set for any measurement function except frequency, period, continuity (FAST) and diode test (Medium). For frequency and period, this value is little excess a gate time.***

4.2 Trigger operation

The millivoltimeter's triggering system allows you to generate triggers either manually or automatically or externally and take multiple readings per trigger. The following paragraphs discuss front panel triggering, and the reading hold feature.

4.2.1 Trigger procedure

Wait for Trigger

The control source holds up operation until the programmable event occurs and is detected. See description below for trigger sources:

- Immediate

With this trigger source, event detection is immediately satisfied allowing operation to continue.

- External

  Event detection is satisfied for both kinds of triggers as below:

  1. A bus trigger (*TRG) command is received.
  2. The front panel Trig key is pressed (TH1912/A must be taken out of remote before it will respond to Trig key).

Take steps below for trigger settings:

1. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **B:TRIG MEU** and press ▼ to enter“Command”，use ◀ or ▶ to find **1:TRIG MOD**E command， press ▼ to enter parameter(**IMM**、**MAN** or **BUS**)setting.
2. Use ◀ or ▶ to select **IMM**, **MAN** or **BUS**, then press Auto to confirm.
3.

Measurement Sample

The primary measurement sample action is a measurement. However, the measurement sample action block could include the following additional actions:

Hold — with hold enabled, the first processed reading becomes the “Seed” reading and operation loops back within the measurement sample block. After the next reading is processed, it is checked to see if it is within the selected window (0.01%, 0.1%, 1% and 10%) of the “seed” reading. If the reading is within the window, operation again loops back within the measurement sample block. This looping continues until the specified number (2 – 100) consecutive readings are within the winder. If one of the readings is not within the window, the instrument acquires a new “seed” reading and the hold process continues.

Reading Hold

When a hold reading is acquired as described in “Measurement Sample”, an audible beep is sounded (if enabled) and the reading is considered a “true measurement”. The reading is held on the display until an “out of window” reading occurs to restart the hold process. The reading hold feature allows you to capture and hold a stable reading on the display.

Take steps below to enable and set reading hold function.

1. Press Shift + Trig to enable reading hold function
2. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **B:TRIG MEU** and press ▼ to enter “command”，use ◀ or ▶ to find **2:HOLD WIN** command，press ▼ to enter parameter selection.
3. Use ◀ or ▶ to select range（0.01% ,0.1% ,1% ,10%）,then press Auto to confirm the selected range.

4. Use [▶] to select **3:HOLD CNT**， press [▼] to enter parameter setting(Default is 5):
   RDGS: 005
5. Use [◀] and [▶] to choose numeric place, then use [▲] and [▼] to increase and decrease value. Enter a value of count.
6. Press [Auto] to confirm set digits（2～100）.

4.3 MAX/MIN

Used to indicate the Max. and Min. value in the process of testing. After opening this function, the instrument starts to record the Max. and Min. value, as well as keep refreshing. It can also be used to test wavery range.

Use the following procedure to turn on the turn on the **MAX / MIN** operation:

1. Press [Max/Min] to enable the **MAX / MIN** function
2. Use [◀] or [▶] key to switch between MAX and MIN.
3. Press [Max/Min] key again to disable the MAX/MIN function.

4.4 Compare Operations

Limit operations set and control the values that determine the HI / IN / LO status of subsequent measurements. Limits can be applied to all measurement functions except continuity. The limit test is performed after percent math operations. Unit prefixes are applied before the limit test, for example:

Low Limit = -1.0, High Limit = 1.0

A 150mV reading equals 0.15V (IN).

You can configure the millivoltmeter to beep or not when readings are outside of the limit range.

4.4.1 Enabling compare

Use the following procedure to turn on the limit operation:

Press [Shift] → [Max/Min] to enable or disable LIMIT TEST function.

4.4.2 Setting Compare Limit Values

Use the following steps to enter high and low limit values:

1. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **A:MATH MEU** and press ▼ to enter“Command”，use ◀ or ▶ to find **1:HIGH LIMIT** command，press ▼ to enter parameter setting：
   HI: +1.0000∧
2. Use ◀ and ▶ to change numeric place, then use ▲ and ▼ to increase and decrease the value. Enter a value of count. Press Auto to confirm high limit value.
3. Use ▶ to select **2:LOW LIMIT**，press ▼ to enter low limit parameter setting:
   LO: -1.0000∧
4. Use ◀ and ▶ to change numeric place, then use ▲ and ▼ to increase and decrease the value. Enter a value of count. Press Auto to confirm low limit value.
5. Press Shift → Esc key to exit from the menu and return to the measurement status.

4.5 System Operations

Model TH1912 has some other operations: Beeper control, key sound control, Baud rate control and Terminal character setup. The information is not directly related to making measurements but is an important part of operating the instrument.

4.5.1 Beep

Normally, the millivoltmeter will emit a tone whenever certain conditions are met. For example: the millivoltmeter will beep when a stable reading is captured in reading hold. You may want to disable the beeper for certain applications.

- When you disable the beeper, the millivoltmeter will not emit a tone when:
  1. A limit is exceeded in a limit test
  2. A stable reading is captured in reading hold.
- Disabling the beeper has no effect on the tone generated when:
  1. An internal error is generated.
  2. The continuity threshold is exceeded.
  3. A front panel key is pressed.
- The beeper state is stored in non-volatile memory and does not change when power has been off or after a reset. The beeper is enabled when the millivoltmeter is shipped from the factory.

Use the following steps to change the beeper’s state:

1. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **C:SYS MEU** and press ▼ to enter“Command”，use ◀ or ▶ to find **1: BEEP** command，press ▼ to enter parameter setting.
2. Use ◀ or ▶ to select **ON or OFF**, then press Auto to confirm.

4.5.2 Key Sound

To avoid mis-operation, Model TH1912/A has key sound function and you can enable or disable it. Factory default setting is enabled. The key sound state is stored in non-volatile memory and does not change when power has been off of after a reset.
Use following steps for key sound setting:

1. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **C:SYS MENU** and press ▼ to enter“Command”，use ◀ or ▶ to find **4:KEY SONG** command，press ▼ to enter key sound setting.
2. Use ◀ or ▶ to select **ON** or **OFF** , then press Auto to confirm.

4.5.3 Self-test

The self-test is a tool of testing the instrument, which can help the operator find the problem as quickly as possible.

TH1912 has the function of booting up self-test, which can prove the instrument can be operated. Booting up self-test is just a part of self-test operation, but the self-test in not included in analogy circuit. Please refer to the information about the use of self-test in TH1912 service manual.

Chapter 5 Remote Operation

Besides the front panel control, TH1912 supports RS-232 serial interface for remote control. Standard Commands for Programmable Instruments (SCPI) is fully supported to communicated with computer via the RS-232 interfaces, with a certain communication protocols.

You can connect RS-232 interface with a computer. Some considerations will draw your attention:

- You must define the baud rate
- You must use the SCPI programming language

5.1 RS-232 Interface Operation

The instrument provides various remote commands. All operations from the front panel can be performed by a computer via the RS-232 interface.

5.1.1 RS-232 Connection

RS232C standard now is widely used as the serial communication standard. RS232 stands for Recommend Standard number 232 and C is the latest revision of the standard.

The serial ports on most instruments use a subset of the RS232C standard. The full RS232C standard specifies a 25-pin “D” connector of which 22 pins are used. Most of these pins are not needed for normal serial communications.

Function	Code	25 Pin connector Pin Number	9 Pin Connector Pin Number
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted Data	TXD	2	3
Received Data	RXD	3	2
Signal Ground Common	GND	7	5

TH1912 only uses the smallest subset of the RS232C standard, the signal are listed as below:

Function	Code	Connector Pin Number
Transmitted Data	TXD	3
Received Data	RXD	2
Signal Ground Common	GND	5

Note: the definition of serial port pin is the same as that of standard 9- core RS232C connector.

RS-232 connector adopts 9-core DB jack，the pin sequence is shown as the figure below：

Rear panel connector

5.1.1 RS-232 operation

(1). The connection of RS232 and computer is shown as figure 5-1：

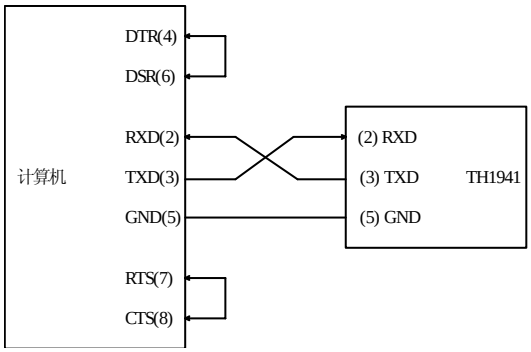


Figure 5-1 RS-232 connection

There may be some difference between TH1912 RS232 interface and a standard RS232C interface. You can make the connection cable by yourself according the diagram or order one from our company.

Note: Pin 4 and 6, pin 7 and 8 are shorted respectively at the end of controller.

(2) Sending and receiving data

TH1912 使用含有起始位和停止位的全双工异步通讯传输方式，RS-232 的数据传输格式为：8 位（bit）数据位，1 位（bit）停止位，没有校验位（bit），结束符为<LF>（换行符，ASCⅡ代码为 10）。

(3) Selecting Baud Rate

The baud rate is the rate at which Model TH1912 millivoltmeter and the computer communicate. Choose one of these available rates:

- 38.4k
- 19.2k
- 9600
- 4800
- 2400
- 1200
- 600

Note: Factory default baud rate is 9600.

Before you choose a baud rate, make sure the programming terminal that you are connecting to the TH1912 can support the baud rate you selected. Both the millivoltmeter and the other device must be configured for the same baud rate.

Perform the following steps to select a baud rate:

1. Press Shift + Esc to load“Menu”，then use ◀ or ▶ to find **C:SYS MEU** and press ▼ to enter“Command”，use ◀ or ▶ to find **2:BAUD RAT** command，press ▼ to enter baud rate parameter; you will see：
   BAUD：<rate>。
2. Use ◀ or ▶ to select the required baud rate, then press Auto to confirm.

3. Press Shift → Esc key to exit from the menu and return to the measurement status.

(4) Software Protocol

Since the hardware handshaking lines CTS and RTS are not used by TH1912, the millivoltmeter uses the character return method to decrease the data losses and errors during communication. Please refer to the content below before programming communication software.

1. For command syntax and format, refer to Chapter 6 Command Reference.

2. The controller transmits the command using the ASCII code with <LF> or <CR> as the terminal character. TH1912 executes the command after the terminal character is received.
3. The character received by TH1912 will be sent back to the controller again. The controller will not send the next character until the last returned character is received correctly from TH1912. If the controller fails to receive the character sent back from TH1912, the possible reasons are listed as follows:
   - The serial interface is not connected correctly.
   - Check if the same baud rate is selected for both TH1912 and the controller.
   - When TH1912 is busy with executing a bus command, TH1912 will not accept any character from the serial interface at the same time. So the character sent by controller will be ignored. In order to make sure the whole command is sent and received correctly, the character without a return character should be sent again by the controller.
4. TH1912 only sends information under following two conditions. The first is when a character is received normally; TH1912 will send the character back as a handshake. The second is when a query command is received; TH1912 will send the query response information.
5. Once a query command is received, TH1912 will send the query response information immediately even if the rest commands have not been finished. So if the command includes two queries, the controller should read the query responses twice. One query is recommended to be included in a single command.
6. A query response is sent out in ASCII codes with the preset terminal character.
7. Several query responses will be sent continuously with 1ms interval. The controller should be ready to receive the responses; otherwise the response information will be lost.
8. The controller should receive the query response terminal character. Otherwise you will confuse a terminal character with a returned character. At the same time the controller should receive the last returned character before receiving a query response.
9. For some commands that will take a long time to execute, for example reset command, the controller should keep waiting to avoid the next command being lost when TH1912 is executing the former command.

.

5.2 **Data format**

TH1912 outputs the measurement results using the ASCII character string format via the RS232 serial interface. The data format is described as below:

SD.DDDDDDESDDD<NL>

S: +/-

D: number 0 to 9

E: exponent sign (“+”is omitted)

<NL>: New Line, ASCII code is 10

Chapter 6 SCPI Command Reference

6.1 Command structure

TH1912 commands are divided into two types: common commands and SCPI commands. The common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. Not all commands are supported by the TH1912. The SCPI commands are used to control all of the TH1912's functions. The SCPI commands are tree structured three levels deep. (The highest level commands are called the subsystem commands in this manual.) So the lower level commands are legal only when the subsystem commands have been selected. A colon (:) is used to separate the higher level commands and the lower level commands. See Figure 6-1 for a sample.

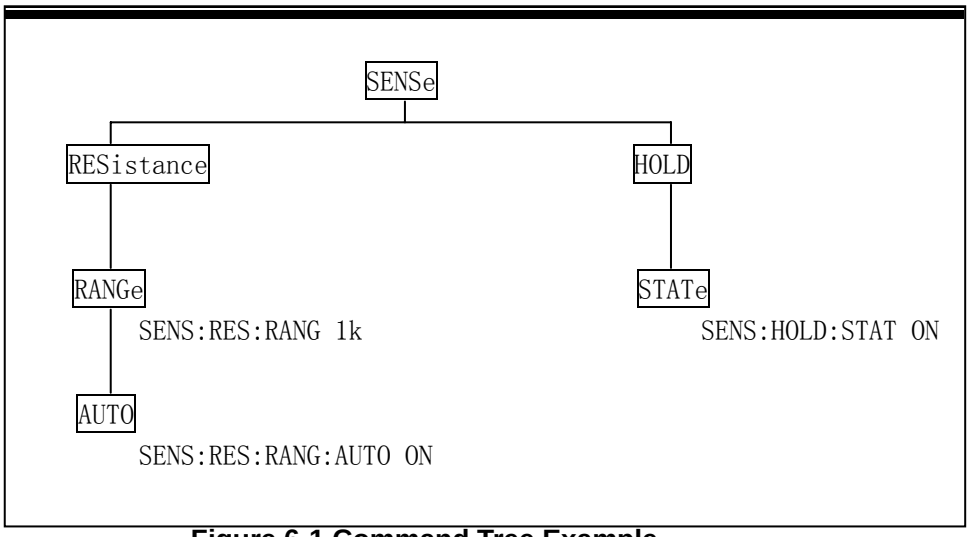


Figure 6-1 Command Tree Example

6.2 Command Syntax

The information in this section covers the syntax for both common commands and SCPI commands.

6.1.1 Commands and command parameters：

Common commands and SCPI commands may or may not use a parameter. The following are some examples:

*RST No parameter used

:FORMat <name> Parameter<name> required
:IMMediate No parameter used

Put at least one space between the command word and the parameter.

- Brackets [ ]: Some command words are enclosed in brackets. These brackets are used to denote an optional command word that does not need to be included in the program message. For example:

  :RANGe[:UPPer] <n>

  These brackets indicate that :UPPer is optional and does not have to be used. Thus, the above command can be sent in one of the two ways below:

  :RANGe <n>
  or :RANGe:UPPer <n>

  NOTICE: When using optional command words in your program, do not include the brackets.

- Angel brackets <>: Angle brackets are used to denote a parameter type. Do not include the brackets in the program message. For example:

  :HOLD:STATe <b>

  The <b> indicates that a Boolean-type parameter is required. Thus, to enable the HOLD feature, you must send the command with ON or 1 parameter as below:

  :HOLD:STATe ON
  or :HOLD:STATe 1

- Parameter types: The following are some of the more common parameter types:

  <b> Boolean: Used to enable or disable an instrument operation. 0 or OFF disables the operation and 1 or ON enables the operation. Example:

  :CURRent:AC:RANGe:AUTO ON Enable auto ranging

<name> Name parameter: Select a parameter name from a listed group. Example:

<name> = MOVing
REPeat

:RESistance:AVERage:TCONtrol MOVing

<NRf> Numeric Representation format: This parameter is a number that can be expressed as an integer (e.g., 6), a real number (e.g., 25.3) or an exponent (e.g., 5.6E2). Example:

:MMFactor 5

<n> Numeric value: A numeric value parameter can consist of a NRf number or one of the following name parameters: DEFault, MINimum, MAXimum. When DEFault parameter is used, the instrument is programmed to the *RST default value. When the MINimum parameter is used, the instrument is programmed to the lowest allowable value. When the MAXimum parameter is used, the instrument is programmed to the largest allowable value. Examples:

:CURRent[:DC]:NPLCycles 1
:CURRent[:DC]:NPLCycles DEFault
:CURRent[:DC]:NPLCycles MINimum
:CURRent[:DC]:NPLCycles MAXimum

6.2.2 Short-form Rules

Use the following rules to determine the short-form version of any SCPI command:

- If the length of the command word is four letters or less, no short form version exists. Example:
  :AUTO =:AUTO
- These rules apply to command words that exceed four letters:
- If the fourth letter of the command word is a vowel, delete it and all the letters after it. Example:
  :immediate =:imm
- Rule exception – The short form version of the following command uses only the first two letters of the word.
  :TCouple = :tc
- If the fourth letter of the command word is a consonant, retain it but drop all the letters after it. Example:
  :format = :form
- If the command contains a question mark (?; query) or a non-optional number included in the command word, you must include it in the short-form version. Example:
  :delay? = :del?
- Command words or characters that are enclosed in brackets ([ ]) are optional and need not be included in the program message.

6.2.3 Basic Rules of Command Structure

- Letter case (upper and low) is ignored.
  For example:
  FUNC:VOLT:DC = func:volt:dc = Func:Volt:Dc
- Spaces (␣ is used to indicate a space) must not be placed before and/or after the colon (:).
  For example:
  (wrong) FUNC␣:␣VOLT:DC
  (right) FUNC: VOLT:DC
- The command can be completely spelled out or in abbreviated type. (In the following description, short form will be printed in upper case.)
  For example:
  FUNCTION: VOLTAGE:DC = FUNC:VOLT:DC
- The command header should be followed by a question mark (?) to generate a query for that command.
  For example:
  FUNC?

6.2.4Multiple Command Rules

The semicolon (;) can be used as a separator to execute multiple commands on a single line. The multiple command rules are as follows.

- Commands at the same level and in the same subsystem command group can be separated by a semicolon (;) on a multiple command line.
  For example:
  :RESistance:NPLCycle <n>;NPLCycles ?
- To restart commands from the highest level, a semicolon (;) must be used as the separator, and then a leading colon (:), which shows that the restarted command is a command at the top of the command tree, must follow.
  For example:
  :RESistance:NPLCycle <n>; :RESistance:NPLCycles ?
- The common commands can restart only after a semicolon on a multiple command line.
  For example,
  :RESistance:NPLCycles<n>;*IDN?

6.2.5 Command Path Rules

- Each new program message must begin with the root command, unless it is optional (e.g., FUNCtion). If the root is optional, simply treat a command word on the next

level as the root.

- The colon at the beginning of a program message is optional and need not be used. Example:
  :DISPlay:ENABle <b> = DISPlay:ENABle <b>
- When the path pointer detects a colon(;), it moves down to the next command level.
- When the path pointer detects a colon (:) after a semicolon (;), it resets back to the root level.
- The path pointer can only move down. It cannot be moved up a level. Executing a command at a higher level requires that you start over at the root command.

Command Reference

Model TH1912 provides following subsystem commands:

◆ DISPlay ◆ FUNCtion ◆ VOLTage ◆ CURRent ◆ RESIstance ◆ FREQuency

◆ PERiod ◆ HOLD ◆ TRIGer ◆ FETCh

Model TH1912 supports following common commands:

◆ *RST ◆ *TRG ◆ *IDN

6.3.1 DISPlay subsystem

The DISPlay subsystem commands are mainly used to control the display of the TH1912/A. and are summarized in Table 6-1.

Table 6-1 DISPlay Subsystem Commands Summary

Command	Function Description
:DISPlay	
:ENABle <b>	Enable or disable front panel dispaly
:ENABle?	Query state of the display

:ENABle <b>

Command syntax:

:DISPlay:ENABle <b>

Command Parameter:

<b> = 0 or OFF Disable front panel display

1 or ON Enable front panel display

Query:

:ENABle? Query state of the display

Description:This command is used to enable or disable front panel display circuitry. When disabled, the instrument operates at a higher speed. While disabled, the display is frozen. All front panel controls except LOCAL are disabled. Normal display operation can be resumed by using:ENABle command or pressing LOCAL key to enable the display.

6.3.2 FUNCtion subsystem

The commands in this subsystem are used to configure the measurement function subsystems and are summarized in Table 6-2.

Table 6-2 FUNCtion Subsystem Commands Summary

Command	Decription

:FUNCtion 〈name〉	Select measurement function： ‘VOLTage:AC’, ‘VOLTage:DC’, ‘RESistance’, ‘FRESistance’, ‘CURRent:AC’, ‘CURRent:DC’, ‘FREQuency’, ‘PERiod’, ‘DIODe’, ‘CONTinuity’.
:FUNCtion?	Query function.

:FUNCtion Command

:FUNCtion <name>

Command syntax:

:FUNCtion <name>

Command Parameter:

<name> =	‘VOLTage:AC’	Select AC Voltage
	‘VOLTage:DC’	Select DC Voltage
	‘CURRent:AC’	Select AC Current
	‘CURRent:DC’	Select DC Current
	‘RESistance’	Select 2-wire Resistance
	‘FRESistance’	Select 4-wire Resistance
	‘FREQuency’	Select Frequency
	‘PERiod’	Select Period
	‘DIODe’	Select Diode Testing
	‘CONTinuity’	Select Continuity Testing

Query:

:FUNCtion?	Query currently programmed function

Description:

This command is used to select the measurement function of the instrument. Note that the parameter names are enclosed in single quotes (’). However, double quotes (“) can instead be used.

For example:

:FUNC ‘VOLT’= :FUNC “VOLT”

Each measurement function “remembers” its own unique setup configuration, such as range, speed, filter and rel. This eliminates the need to re-program setup conditions every time you switch from one function to another.

6.3.3 VOLTage subsystem

The commands in this subsystem are used to configure and control voltage measurement function and are summarized in Table 6-3.

Table 6-3 VOLTage Subsystem Commands Summary

Command	Function Description	Default
:VOLTage:DC	Path to configure DC voltage	
:NPLCycles <n>	Set integration rate (line cycle; 0.5 to 2)	1
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to configure measurement range	
[:UPPer] <n〉	Select range (0 to 1010)	1000
[:UPPer]?	Query range	
:AUTO <b>	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	Specify reference (-1010 to 1010)	0
:STATe <b>	Enable or disable reference	OFF
:STATe?	Query state of reference (0,1)	
:ACQuire	Use input signal as reference.	
:REFerence?	Query reference value	
:VOLTage:AC	Path to configure AC voltage	
:NPLCycles <n>	Set integration rate (line cycles; 0.5 to 2)	1
:NPLCycles?	Query line cycle integration rate	
:RANGe	Path to set measurement range	
[:UPPer] <n〉	Select range (0 to 757.5)	757.5
[:UPPer]?	Query range	
:AUTO <b>	Enable or disable auto range	ON
:AUTO?	Query auto range	
:REFerence <n>	specify reference (-757.5 to 757.5)	0
:STATe <b>	Enable or disable reference	OFF
:STATe?	Query state of reference	
:ACQuire	Use input signal as reference	
:REFerence?	Query reference value	

Speed Commands

: NPLCycles <n>

Command Systac:

:VOLTage:AC:NPLCycles <n> Set NPLC for ACV

:VOLTage:DC:NPLCycles <n> Set NPLC for DCV

Command Parameter:

<n> = 0.5 to 2 Set power line cycles per integration

DEFault 1

MINimum 0.5

MAXimum 2

Query:

:NPLCycles? Query programmed NPLC value

Description:

The integration period (measurement speed) for the basic measurement functions (except Frequency and Period) is set using the:NPLCycles command. NPLC(Number of Power Line Cycles) expresses the integration period by basing it on the power line frequency. For example, for a PLC of 1, the integration period in seconds would be1/60 (for 60Hz line power) which is 16.67 msec.

:RANGe Commands

:[UPPer] <n>

Command syntax:

:VOLTage:AC:RANGe[:UPPer] <n>	Set measurement range for ACV
:VOLTage:DC:RANGe[:UPPer] <n>	Set measurement range for DCV

Command Parameter:

<n> =	0 to 757.5	Expected reading is AC volts (ACV)
	0 to 1010	Expected reading is DC volts (DCV)
	DEFault	757.5 (ACV)
		1000 (DCV)
	MINimum	0 (All functions)
	MAXimum	Same as DEFault

Query:

:RANGe[:UPPer]? Query measurement range of the current function.

Description:

This command is used to manually select the measurement range for the specified measurement function. The range is selected by specifying the expected reading as an absolute value. The instrument will then go to the most sensitive range that will accommodate that expected reading. For example, if you expect a reading of approximately 20mV, simply let the parameter (<n>) =0.02 (or 20e-3) in order to select the 200mV range.

:AUTO <b>

Command syntax:

:VOLTage:AC:RANGe:AUTO <b>	Set auto range for ACV
:VOLTage:DC:RANGe:AUTO <b>	Set auto range for DCV

Command parameter:

<b> =	1 or ON	Enable auto range
	0 or OFF	Disable auto range

Query:

:AUTO?	Query auto range (ON or OFF)

Description:

These command are used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement.

The auto range command (:RANGe:AUTO) is coupled to the command that manually selects the measurement range (:RANGe <n>). When auto range is enabled, the parameter value for :RANGe <n> changes to the automatically selected range value. Thus, when auto range is disabled, the instrument remains at the automatically selected range. When a valid :RANGe <n> command is sent, auto ranging disables.

:REFerence <n> Commands

:REFerence <n>

Command syntax:

:VOLTage:AC:REFerence <n>	Specify reference for ACV
:VOLTage:DC:REFerence <n>	Specify reference for DCV

Command parameter:

<n> =	-757.5 to 757.5	Reference for ACV
	-1010 to 1010	Reference for DCV
	DEFault	0 (All measurement functions)
	MINimum	Mininum value for specified function
	MAXimum	Maximum value for specified function

Query:

:REFerence?	Query reference for relative function

Descripton:

These commands are used to establish a reference value for the specified function. When reference is enabled (:REFerence:STATe), the result will be the algebraic difference between the input signal and the reference value:

Reading = Input signal – Reference

From the front panel, reference is called relative (REL).

The:REFerence <n> command is coupled to the :ACQuire command. The last command sent (:REFerence <n> or :ACQuire) eatablishes the reference. When a reference is set using the:REFerence <n> command, the REFerence? Query

command returns the programmed value. Conversely, when a reference is set using the:ACQuiry command, the:REFerence? Query command returns the acquired reference value.

:STATe <b>

Command syntax:

:VOLTage:AC:REFerence:STATe <b>	Control reference for ACV
:VOLTage:DC:REFerence:STATe <b>	Control reference for DCV

Command parameter:

<b> =	1 or ON	Enable reference
	0 or OFF	Disable reference

Query:

:STATe?	Query state of reference.

Description:

These commands are used to enable or disable Reference for the specified function. When enabled, the displayed reading will include the programmed reference value. When disabled, the displayed reading will not include the reference value.

:ACQuire

Command syntax:

:VOLTage:AC:REFerence:ACQuire	Acquire reference for ACV
:VOLTage:DC:REFerence:ACQuire	Acquire reference for DCV

Description:

When one of these commands is sent, the measurement input signal is acquired and established as the reference value. This command is typically used to zero the display. For example, if the instrument is displaying a 1μV offset, sending this command and enabling Reference zeroes the display.

This command is functional only if the instrument is on the specified measurement function. Sending this command while in any other function causes an error. Also, if the latest reading is overflowed or a reading has not been triggered, an error occurs when this command is sent.

6.3.4 HOLD subsystem

The commands in this subsystem are used to configure and control hold measurement function and are summarized in Table below

Command	Function Description	Default
:HOLD	Path to control Hold feature:	
:WINDow <NRf>	Set Hold window(%); 0.01 to 10	1
:WINDow?	Query Hold window	
:COUNt <NRf>	Set Hold count; 2 to 100	5
:COUNt?	Query HOLD count	
:STATe <NRf>	Enable or disable HOLD	OFF
:STATe?	Query state of HOLD	

:HOLD Command

The following commands are used to configure and control the HOLD feature.

:WINDow <NRf>

Command syntax:

:HOLD:WINDow <NRf>

Command Parameter:

<NRf> = 0.01 to 10 Set window (percent)

Query:

:WINDow? Query Hold window

Description:

This command is used to set the window for HOLD. This window is expressed as a percent of the “seed” reading for the Hold process.

:COUNt <NRf>

Command syntax:

:HOLD:COUNt <NRf>

Command Parameter:

<NRf> = 2 to 100 Specify HOLD count

Query:

:COUNt? Query HOLD count.

Descripton:

This command is used to specify the count for HOLD. COUNt is the number of readings that are compared to the “seed” reading during the HOLD process.

:STATe <b>

Command syntax:

:HOLD:STATe <b>

Command Parameter:

<b> = 0 or OFF Disable HOLD

1 or ON Enable HOLD

Query:

:STATe? Query state of HOLD

6.3.5 TRIGger subsystem

These commands in this subsystem are used to configure and control trigger measurement function and are summarized in Table below

Command	Function Description	Default
:TRIGger :SOURce <name> :SOURce?	 Select control source Query control source	 IMMediate

:TRIGger

TRIGger subsystem commands are used for the instrument settings of trigger mode, trigger delay and trigger a measurement.

:SOURce <name>

Command Syntax:

TRIGger:SOURce <name>

Command parameter:

<name> = IMMediate instrument default setting is internal trigger)

BUS Triggered via RS232 interface)

MANual(EXTernal) (Press Trig in the front panel for Trigger)

Query:

:SOURce? Query control source)

Description:

These are used to select the event control source.

6.3.6 FETCH Subsystem

FETCh? Command

Command syntax:

:FETCh?

Description:

This query command is used to obtain the lastest post-processed reading. This command does not affect the configuration of the instrument.

This command does not trigger a measurement. The command simply requests the last available reading. This command continues to return the same old reading, until there is a new reading.

This command will be automatically asserted when :READ? or :MEASure? command is sent.

6.3.7 Common Commands

Common commands can be used to all equipments. We provide some common commands as below:

***RST**

Command Syntax:

*RST

Description:

Reset the instrument

*TRG

Command Syntax:

*TRG

Description:

Trigger the instrument for measurement

*IDN?

Query Syntax:

*IDN?

Query return:

<product>,<version><LF^END>

Here:

<product> TH1912/A Digital AC Milivoltmeter

<version> Ver1.0

Description:

Query information returned to instrument

Appendix A

Specification

Introduction

Appendix A describes the complete specifications of the Model TH1912 Millivoltemter.

Technical Specifications

- **Specifications Assumptions**

  - One year calibration cycle.
  - Operating temperature at 18℃ to 28℃
  - Accuracy is expressed as: ±(% of reading + digits) after 30 minutes' warm-up.
  - Temperature Coefficient: add ± [0.1% × (the applicable accuracy)/℃] for 0℃ to 18℃ and 28℃ to 40℃;
  - Relative Humidity: Up to 80% for 0℃ to 28℃. Up to 70 for 28℃ to 40℃.

● Displayed reading and reading rate

Full scale reading ：

Slow	Med	Fast
38000	38000	3800

● Frequency response error of test voltage：（f=1KHz）

- 5Hz~20Hz ±(reading4%+full range0.5%)
- >20Hz~2MHz ±(reading 2%+full range0.5%)
- >2MHz~3MHz ±(reading 3%+full range0.5%)
- >3MHz~5MHz ±(reading 4%+full range0.5%)
-

Triggering and Memory

Reading hold sensitivity: 0.01%, 0.1%, 1% or 10% of reading
Programming trigger delay: 0～6000ms (with step of 1ms)
Memory: save 512 reading

Math function

Rel, Max./Min./Average/standard error (stored reading) ，dBm, dB, Limit Test, % and mX+b.
dBm reference resistance value:automatically set 1Ω～9999Ω(with the stepper of 1Ω),default is 75Ω.

Standard program language

SCPI（Standard Commands for Programmable Instruments）

Remote interface

GPIB(IEEE-488.2) and RS-232C

General specification

Power requirement: 220V±10%
Power frequency: 50/60Hz±5%
Power consumption: ≤20VA
Working temperature: 0℃～40℃，≤90%RH，
Stored environment: -40℃～70℃
Warming up time: at least 30 minuets
Dimention（W×H×D）：225mm×100mm×315mm
Weight: about 2.5 Kg
Warrenty period:2 years

Appwndix B

Example of program

Serial interface program

The example is a communication program written with C language under pure DOS environment, main function can expand communication function by user, and subfunction decribes how to use serial interface to input and output string.

```
#define PORT 0
#include "dos.h"
#include "stdio.h"
#include "stdlib.h"
#include "ctype.h"
#include "string.h"
#include "conio.h"

void port_init( int port,unsigned char code );
int check_stat( int port );      /* read serial port state(16bit) */
void send_port( int port,char c );/* send a character to serial port */
char read_port( int port );   /* recive a character form serial port */

void string_wr( char *ps );    /* write a string to serial port */
void string_rd( char *ps );    /* read a string from serial port */

char input[256];                    /* quary recieve bufer */


main()
{ port_init( PORT,0xe3 );/* initilize serial port:baud = 9600,no verify,1 bit stop,8
                            bit data */
  string_wr( "trig:sour bus;*trg" );
  string_rd( input );
  printf( "\n%s",input );

  string_wr( "volt:dc:rang 1.0" );
  string_wr( "func 'volt:ac' );
}
```

```
/* write string to serial port */
void string_wr( char *ps )
{ char c;
  int m,n;
  while( check_stat(PORT) & 256) read_port(PORT);/* read data until null */
  for( ;*ps;  )
  { c = 0;
    for( m = 100;m;m-- )
    { send_port( PORT,*ps );
      for( n = 1000;n;n-- )
      { delay(2);  /* wait about 2ms,can use dos.h libray funtion:delay */
        if( kbhit() && ( getch() == 27 ) )  /* if escape key keypress */
        { printf( "\nE20:Serial Port Write Canceled!" );
          exit(1);
        }
        if( check_stat(PORT) & 256 )
        { c = read_port( PORT );
          break;
        }
      }
      if( n ) break;
    }
    if( c == *ps ) ps++;
    else
    { printf( "\nE10:Serial Port Write Echo Error!" );
      exit(1);
    }
  }
  send_port( PORT,'\n' );/* send command end symbol */
  delay( 2 );
  while( !(check_stat(PORT) & 256) );
  read_port( PORT );
}
```

```
/* read string from serial port */
void string_rd( char *ps )
{ unsigned char c,i;
  for( i = 0;i < 255;i++ )  /* max read 256 characters */
  { while( ! (check_stat(PORT) & 256) )   /* wait serial recieve ready */
    if( kbhit() && (getch() == 27) )    /* if escape key keypress */
    { printf( "\nE21:Serial Port Read Canceled!" );
      exit(1);
    }
    c = read_port( PORT );
    if( c == '\n' ) break;
    *ps = c;
    ps++;
  }
  *ps = 0;
}

/* send a character to serial port */
void send_port( int port,char c )
{ union REGS r;
  r.x.dx = port;          /* serial port */
  r.h.ah = 1;             /* int14 function1:send character */
  r.h.al = c;             /* character to be sent */
  int86( 0x14,&r,&r );
  if( r.h.ah & 128 )  /* check ah.7,if set by int86( 0x14,&r,&r ),mean trans error
                         */
  { printf( "\nE00:Serial port send error!" );
    exit(1);
  }
}

/* read a character from serial port */
char read_port( int port )
{ union REGS r;
```

```
  r.x.dx = port;          /* serial port */
  r.h.ah = 2;             /* int14 function2:read character */
  int86( 0x14,&r,&r );
  if( r.h.ah & 128 )      /* if ah.7 be set,mean trans error */
  { printf( "\nE01:Serial port read error!" );
    exit(1);
  }
  return r.h.al;
}

/* check the status of serial port */
int check_stat( int port )
{ union REGS r;
  r.x.dx = port;          /* serial port */
  r.h.ah = 3;             /* int14 function3:read status */
  int86( 0x14,&r,&r );
  return r.x.ax;        /* ax.7 show serial operation, ax.8 show serial recive ready
                           */
}

/* initialize the serial port */
void port_init( int port,unsigned char code )
{ union REGS r;
  r.x.dx = port;        /* serial port */
  r.h.ah = 0;           /* int14 function0:initial serial port */
  r.h.al = code;        /* initialization code */
  int86( 0x14,&r,&r );
}
```